

# EXHIBIT A

## **Expert Disclosure – Professor Robert Battalio**

(December 8, 2023)

Professor Robert Battalio is a Professor of Finance at the Mendoza College of Business at the University of Notre Dame with expertise in trading, securities markets, and micro-market analysis.

### **A. Qualifications and Prior Testimony**

Professor Battalio received a bachelor's degree in Economics in 1988 from Texas A&M University. He graduated with a Ph.D. in Finance from Indiana University in 1995.

Professor Battalio has researched and taught courses on the subjects of trading and markets for over fifteen years. Since 2007, Professor Battalio has been a Professor of Finance at the Mendoza College of Business at the University of Notre Dame. Between January 2019 and June 2022, Professor Battalio also served as the Department Chair for the Department of Finance at the University of Notre Dame. Prior to his appointment, Professor Battalio spent nearly a decade as an Associate Professor of Finance at the University of Notre Dame, and also spent one year as an Associate Professor of Finance at Georgia State University. Professor Battalio has also served as a Visiting Academic Fellow at Nasdaq's Economic Research Team, and a Visiting Scholar at the Federal Reserve Bank of Atlanta. Professor Battalio is currently a member of Nasdaq's Quality of Markets Committee.

Over the past 20 years, Professor Battalio has published numerous articles in peer-reviewed academic journals. Professor Battalio's research and writing has explored, among other things, equity and options market structure, order routing and execution, high frequency trading, electronic liquidity providers, and payment for order flow. In addition to publishing, Professor Battalio was also named an associate editor for the *Journal of Financial Markets* in 2006, and an associate editor for the *Financial Review* in 2010. Professor Battalio's *curriculum vitae*, which lists all of Professor Battalio's published writings, is attached hereto as Appendix A.

Professor Battalio has never previously testified as an expert witness at trial. In the last four years, Professor Battalio was deposed as an expert in *SEC v. Suyun Gu*, No. 21 Civ. 17578 (D.N.J.).

Professor Battalio is being compensated for his time at the rate of \$650 per hour. His work is being supported by personnel at the consulting firm Integra FEC, which has performed research and analysis under his direction. Integra FEC is being compensated separately for its work on this matter. Neither Professor Battalio's compensation nor that of Integra FEC is contingent upon Professor Battalio's testimony or the outcome of this matter.

### **B. Data Sources**

Professor Battalio's data sources are set forth in Appendix B. For ease of reference, this disclosure refers to certain data sets as follows:

- “Archegos Order and Execution Records” refers to Archegos’s trade blotter, Archegos’s daily combo sheets, and the Archegos order information captured by EMSX, the Bloomberg order execution management system.
- “Archegos Trading IB Records” refers to the set of recurring Instant Bloomberg messages between Bill Hwang, William Tomita, Daiki Taniguchi, and Peter DeSanto.
- “Nasdaq Order Book Data” refers to the quotation and execution data maintained by Nasdaq.
- “NYSE Daily TAQ Data” refers to daily trade-and-quote data maintained by the New York Stock Exchange (“NYSE”).
- “NYSE Integrated Feed” refers to order and execution data for NYSE markets.
- “Marketwide Trade Data” refers to (a) the National Best Bid and Offer data and (b) security, return, and volume information maintained by the Center for Research in Securities Prices, LLC.

In addition to the materials identified in Appendix B and the studies, analyses, and data described below in Section C, Professor Battalio’s observations and opinions are further based on his academic research and professional experience.

### **C. Anticipated Opinions**

The Government anticipates that, if called as a witness, Professor Battalio will provide summary statistics regarding Archegos’s portfolio, Archegos’s orders and linked trades, and the market consequences of Archegos’s orders and trading activities. More specifically, the Government anticipates that Professor Battalio may offer the following testimony and opinions:

1. Professor Battalio’s testimony may include background terms and concepts related to trading and markets, such as:
  - a. A “public company” is a company that has issued stock that is traded on a stock exchange.
  - b. A “security” is, among other things, any note, stock, bond, debenture, evidence of indebtedness, investment contract, or participation in any profit-sharing agreement.
  - c. A “stock” is a specific type of investment signifying ownership in a corporation, and represents a claim on the corporation’s assets and earnings. Stock is measured in shares, which investors can buy and sell. “Outstanding shares” generally refers to the number of shares of stock held by all of the company’s shareholders. “Float” generally refers

to the portion of a company's outstanding shares of stock that are available for investors to trade.

- d. A "swap" is a derivative contract through which two parties exchange financial instruments. One type of swap is a "total return swap," which is a swap agreement in which one party makes payments based on a set rate while the other party makes payments based on the return of an underlying asset. A total return swap enables a party to receive the economic benefit of a reference asset without owning it. A "bullet swap" is a form of swap that settles at full maturity, usually in the form of a single net payment.
- e. The International Swaps and Derivatives Association ("ISDA") is a financial industry association made up of market participants and market infrastructure firms that seeks to foster safe and efficient derivatives markets to facilitate effective risk management for all users of derivative products. Among other things, ISDA develops and distributes standardized documentation for use by industry participants seeking to engage in derivatives transactions. Parties to derivatives transactions may negotiate and customize the terms of their transaction, including as to price and settlement.
- f. An "ADR" is an American Depositary Receipt, which is a certificate representing shares of a foreign security. ADRs may be listed on a national securities exchange in the United States. ADRs enable indirect ownership of foreign securities that are not traded directly on a national exchange in the United States.
- g. A "broker" is any person who facilitates stock transactions for the accounts of others. A "brokerage firm" is an entity that brings together buyers and sellers to facilitate a stock transaction. Domestic brokers and brokerage firms generally are required to register with the Securities and Exchange Commission ("SEC") and the Financial Industry Regulatory Authority ("FINRA").
- h. A "prime broker" is a financial institution that offers a bundle of financial services to sophisticated investors. Services may include securities brokering, margin lending, and cash management.
- i. A "long" position is an investment position that appreciates in value as the underlying securities appreciate in value. A "short" position is an investment position that appreciates in value as the underlying securities decrease in value.
- j. "Short selling" is a type of trade wherein an investor borrows a security, sells it on the open market, and expects to buy it back later at a lower price. "Short selling" is typically profitable when the price of the security declines after it has been borrowed and sold.
- k. A "margin account" is a type of brokerage account in which a broker-dealer lends its customer cash to purchase securities, and the customer offers the investments in the account as collateral. To buy "on margin" means to use the money borrowed from a broker to purchase a security. A "margin call" is a demand from the broker that the customer add money to the account.

- l. The New York Stock Exchange and Nasdaq are stock exchanges where stocks are traded, bought, and sold. Shares on the NYSE and Nasdaq trade through brokerage firms that execute buy and sell transactions on behalf of clients who have accounts with their firms. NYSE, Nasdaq, and other American exchanges capture electronic data regarding securities transactions and offers to buy and sell securities.
- m. The National Market System (“NMS”) refers to the SEC-regulated system of exchange-based trading, and NMS rules apply to American exchanges, such as NYSE and Nasdaq. The NMS requires, among other things, that exchanges make bids and offers available and visible to both retail and institutional investors and that brokers provide at least the national best bid and offer quoted price to customers at the time of a trade.
- n. A “dark pool” is an alternative trading system in which only certain investors are permitted to trade and in which trades are facilitated anonymously.
- o. A “hedge fund” is an institutional investor that manages a pool of investor money in an effort to make a positive return. Hedge funds are subject to regulation by the SEC as investment advisors and therefore must publicly file periodic reports and disclosures.
- p. The phrase “family office” refers to an investment company that is owned by and manages the investments of a single family as opposed to the investments of multiple private investors. A “family office” typically is exempted from the SEC disclosure and filing rules that apply to hedge funds and other investment advisors.
- q. “Rehypothecation” refers to a practice whereby brokerages use client collateral for their purposes. A brokerage, for example, may temporarily lend a client’s stock to a short seller.
- r. “Trade imbalance” is a measure of the extent to which buy orders exceed sell orders in a market for a given stock, or vice versa. A measure of trade imbalance may be normalized by shares outstanding, daily volume, or some other metric.
- s. “Parent order” is a large order for an asset broken down into smaller orders (“child order”) for execution.
- t. “Child order” refers to a subset of a parent order which has been broken up into smaller orders to minimize price impact.
- u. “Trading algorithm” is a method of executing large parent orders using automated preprogrammed trading instructions accounting for variables such as time, price, and volume.

2. Professor Battalio will explain how securities exchanges, such as Nasdaq and NYSE, function, what trade and order information is captured by the market itself, what information is broadcast to market participants, and how securities transactions occur within them. More specifically:
  - a. Professor Battalio will explain that Nasdaq and NYSE, like all securities exchanges, feature electronic order books that reflect bids—that is, offers to buy a security at a given price and size—and asks—that is, offers to sell a security at a given price and size. Professor Battalio will explain that the “order book” is a record of outstanding buys and sells for a particular asset, usually maintained by an exchange. Nasdaq, NYSE, and other exchanges that are part of the NMS broadcast “top of the book” information to participants who subscribe to the market data feed, which is available commercially through services like Bloomberg.
  - b. Professor Battalio will explain that certain market participants can place bids and offers into the market, modify existing orders, and receive electronic confirmation that an order has been placed, filled, modified, or canceled.
  - c. Professor Battalio will explain that the “best bid” price is the prevailing highest price that a participant is willing to pay for a security on a given exchange, and that the “best offer” price is the prevailing lowest price that a participant is willing to accept to sell a security on a given exchange. Professor Battalio will explain that the “bid-ask spread” is the amount by which the best offer price exceeds the best bid price for a security. The “national best bid and offer” (“NBBO”) reflects the best bid and offer price for a security aggregated across all exchanges. The midpoint of the stock price is the average of the best bid and best offer. In a well-functioning market, the midpoint of a security is a proxy for the fundamental value of that security at a given point in time.
  - d. Professor Battalio will further explain the difference between “active” orders, which execute immediately against resting bids or offers, and “passive” orders, which will not execute unless another market participant bids or offers at the price specified in the passive order. Professor Battalio will also explain that “non-marketable limit orders” are standing orders to purchase or (sell) shares at a maximum (or minimum) stock price and that they either execute, expire at close, or are canceled. Professor Battalio will explain “Immediate or Cancel” orders (“IOC orders”) are orders where one of three outcomes immediately happen when placed: They are filled in whole; filled in part and then canceled (only if a limit price is specified); or canceled if no existing limit order is inside their limit price.
  - e. Professor Battalio will explain that electronic markets have “display orders,” which are visible to market participants, “non-display orders,” which are not visible to market participants, and “reserve orders,” which are orders where a portion is displayed and a remainder is not.
3. Professor Battalio will provide summary statistics and graphical representations reflecting the price and trade volume for equities traded under the ticker symbols VIAC, DISCA,

DISCK, GSX,<sup>1</sup> IQ, TME, VIPS, BIDU, FTCH, and TCBI (the “Archegos Top Long Positions”) and FUTU and RKT (the “Archegos Top Short Positions”) (the “Archegos Top Long Positions” and the “Archegos Top Short Positions” are collectively the “Top Archegos Securities”) during 2020 and 2021 and at various points and intervals within 2020 and 2021.

4. Professor Battalio will provide summary statistics and graphical representations of Archegos’s portfolio and market activities between March 2020 and March 2021. This summary presentation will include the following:
  - a. Professor Battalio will use the Archegos Order and Execution Records to describe the composition and value of Archegos’s portfolio and changes to the composition and value of the portfolio over time.
  - b. Professor Battalio will use the Archegos Order and Execution Records to summarize Archegos’s trading on specific days, including the time, size, prices, handling instructions, and venue routing of orders placed by Archegos.
  - c. Professor Battalio will use the Nasdaq Order Book Data, the NYSE Daily TAQ Data, and the Marketwide Trade Data to summarize Archegos’s orders as a portion of activity on the exchanges and in relation to the activity of other market participants trading on the exchanges. Professor Battalio will present summary statistics reflecting market participation attributable to Archegos’s orders, including Archegos’s share of market volume, median order size, average best ask quantity, share of orders in excess of best ask quantity, and share of immediate or cancel volume.
  - d. Professor Battalio will use the Marketwide Trade Data to present summary statistics regarding how often Archegos-linked orders were at the National Best Bid.
  - e. Professor Battalio will use Archegos Order and Execution Records to quantify the use of trading algorithm order instructions. Based on his academic research, industry experience, and review of various brokerage algorithmic execution trading guides, Professor Battalio will explain the differences between various algorithmic execution strategies, including VWAP (that is, volume-weighted average price), TWAP (that is, time-weighted average price), Target Percentage of Volume/Volume in Line/Participate, and dark pool-associated algorithms such as Morgan Stanley NightOwl or UBS TapDark.
5. Professor Battalio will opine that Archegos’s trade orders in swaps in the Top Archegos Securities can be associated with equity transactions in the National Market System—including NYSE and Nasdaq—and dark pools by matching price, quantity, order handling,

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<sup>1</sup> “GSX” is now listed under the symbol “GOTU.”

and routing information from the Archegos Order and Execution Records to market trade data.

6. Professor Battalio will opine that Archegos-linked trading altered the prevailing market prices of the Archegos Top Long Positions on national markets, including the NYSE and Nasdaq markets, on multiple days between March 2020 and March 2021 and consistently between October 2020 and March 2021.
  - a. Based on economic research literature, Professor Battalio will opine that trade imbalances lead to changes in market prices in exchange-traded markets. For example, a large buy imbalance can lead to rising prices in a market; a large sell imbalance can lead to falling prices in a market.
  - b. Professor Battalio will summarize the academic literature that shows that when a security is added to an index (an “addition”), such as the S&P 500, it has an observable impact on the market price of that security—namely, the price rises—and conversely that when a security is removed from an index (a “deletion”) it has an observable impact on the market price of that security—namely, the price falls. Professor Battalio will explain that academic research has demonstrated that the price impact derives from index fund transactions’ impact on the amount of circulating stock: “As firms enter the S&P 500, index-fund buying removes a substantial fraction of the firm’s shares from circulation. This demand by index funds reduces the stock’s supply for nonindexing investors, causing the market clearing price to increase. For deletions, analogous logic predicts a price decrease.”<sup>2</sup>
  - c. Professor Battalio will present a vector auto regression (“VAR”) analysis that demonstrates a statistically significant relationship between Archegos’s trading imbalance in the Archegos Top Long Positions and changes in prevailing stock prices for the Archegos Top Long Positions. Professor Battalio’s VAR analysis will regress minute price changes on Archegos’s contemporaneous and lagged trade imbalance, as well as lagged prices.<sup>3</sup>
  - d. Professor Battalio will explain that stock price data in the months following Archegos’s collapse further evidences an explanatory relationship between Archegos’s orders in the Top Archegos Securities and changes in prevailing stock prices for those securities.

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<sup>2</sup> Lynch, Anthony W., and Richard R. Mendenhall. “New evidence on stock price effects associated with changes in the S&P 500 index.” *The Journal of Business* 70, no. 3 (1997): 351-383 at 353-354.

<sup>3</sup> See, for example, Griffin, John M., Jeffrey H. Harris, and Selim Topaloglu. “The dynamics of institutional and individual trading.” *The Journal of Finance* 58, no. 6 (2003): 2285-2320.



- e. Based on a micro-market price impact analysis of the Nasdaq Order Book Data and the Archegos Order and Execution Records, Professor Battalio will opine that Archegos's order activity consistently and significantly altered the midpoint of the bid-ask spread for DISCA, DISCK, IQ, and VIAC on Nasdaq exchanges between October 2020 and March 2021. Professor Battalio will show the extent to which Archegos's trades executed on Nasdaq exchanges were large enough to clear the order book at the best bid or best ask, resulting in a change to the midpoint price.<sup>4</sup>
  - f. Based on a micro-market price impact analysis of the NYSE Daily TAQ Data and the Archegos Order and Execution Records, Professor Battalio will opine that Archegos's order activity consistently and significantly altered the midpoint of the bid-ask spread for the Archegos Top Long Positions on NYSE markets between October 2020 and March 2021. Professor Battalio will show the extent to which Archegos's trades executed on NYSE exchanges were large enough to clear the order book at the best bid or best ask, resulting in the midpoint price changing.<sup>5</sup>
  - g. Based on a micro-market price impact analysis of the Marketwide Trade Data and the Archegos Order and Execution Records, Professor Battalio will opine that Archegos's order activity consistently and significantly altered the midpoint of the national best bid and offer price for the Archegos Top Long Positions between October 2020 and March 2021.<sup>6</sup>
7. Professor Battalio will opine that Archegos's order submission strategies were consistent with a strategy to influence market prices in the Archegos Top Securities and inconsistent with a strategy to build concentrated positions in the Top Archegos Securities at the best available prices.
- a. Professor Battalio will opine that investing in equities markets, like in all financial markets generally, follows the simple logic of "buy low, sell high" where investors seek to gain by acquiring an asset at as low of a price as possible, and then to sell that asset at as high of a price as possible, with the intent of earning a profit. It follows that an investor pursuing an economically sensible strategy to buy the Archegos Top Securities would seek to buy at the lowest possible price and to sell at the highest possible price to maximize potential profits from its strategy.

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<sup>4</sup> See, for example, Conrad, Jennifer, and Sunil Wahal. "The term structure of liquidity provision." *Journal of Financial Economics* 136, no. 1 (2020): 239-259. See also Chakravarty, Sugato. "Stealth-trading: Which traders' trades move stock prices?." *Journal of Financial Economics* 61, no. 2 (2001): 289-307.

<sup>5</sup> See *id.*

<sup>6</sup> See *id.*

- b. Professor Battalio will opine that the economically sensible strategy when buying or selling equities is to seek to minimize the price impact of that trading on the market. This is because traders typically execute multiple trades to buy or sell a large volume of equities (as Archegos did) and want to be able to execute the later trades at better prices. In other words, if traders are buying, they typically aim to avoid having their trading push the market price up, avoid consistently beating the best price on the trading platforms, and avoid making their intent to buy large volumes clear to the market. Conversely, if traders are selling, they typically aim to avoid having their trading push the market price down, avoid clearing outstanding orders on the trading platforms, and avoid making their intent to sell large volumes clear to the market. Professor Battalio will explain that academic research generally demonstrates that it is more efficient to divide trades into smaller transactions and spread them out over longer periods rather than execute large orders quickly.<sup>7</sup>
- c. Professor Battalio will opine that in the absence of impending value-relevant news, investors taking a long position can minimize the cost of establishing a position by trading lower volumes over longer time periods, as research has shown that trade size is an important variable in determining price impact.<sup>8</sup> Professor Battalio will also opine that investors can minimize costs by trading on information-constricted trading systems, such as dark pools.<sup>9</sup>
- d. Based on the Archegos Order and Execution Data and the Archegos Trading IB Records, Professor Battalio will opine that the Archegos trading team repeatedly made uneconomic trades. For example:
  - i. Professor Battalio will identify multiple instances in which Archegos bought and short-sold the same stock, including on the same day. Professor Battalio will identify instances of this trading pattern in the BIDU, DISCA, GSX, and VIAC tickers. Professor Battalio will further opine that certain of the trades in BIDU, GSX, VIAC, FUTU, and DISCA were internally inconsistent in that Archegos sought long exposure to particular stocks at prices that exceeded prices at which Archegos had recently sought short exposure to the same stock.
  - ii. Professor Battalio will identify multiple instances in which Archegos increased limit prices to limits in excess of the prevailing market prices and increased limit prices and order sizes near the end of the trading day.

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<sup>7</sup> See, for example, Bertsimas, Dimitris, and Andrew W. Lo. "Optimal control of execution costs." *Journal of financial markets* 1, no. 1 (1998): 1-50.

<sup>8</sup> See, for example, Frazzini, Andrea, Ronen Israel, and Tobias J. Moskowitz. "Trading costs." Available at SSRN 3229719 (2018).

<sup>9</sup> See, for example, Beason, Tyler, and Sunil Wahal. "The anatomy of trading algorithms." Available at SSRN 3497001 (2020).

- iii. Professor Battalio will present analysis of Archegos's orders and executions of Top Archegos Securities demonstrating that Archegos was more likely—for buys relative to sells of Top Long Positions and sells relative to buys of Top Short Positions—to place orders which resulted in trades being executed using strategies or through venues that were more likely to have price impact in the direction of Archegos's position.
  - iv. Professor Battalio will identify multiple instances in which Archegos placed orders that prioritized a percentage of market buy volume—including by using "trading-in-line" or "participate" algorithms—that made it more likely that those orders would be filled at worse prices than had Archegos used different order-handling instructions.
  - v. Professor Battalio will identify multiple instances in which Archegos placed orders or increased orders with instructions to use VWAP—that is, volume weighted average price—to fill the order. Professor Battalio will opine that placing orders near the end of day with VWAP instructions will cause the order to be filled aggressively because the VWAP algorithm will attempt to completely fill the order before the end of regular trading hours.
  - vi. Professor Battalio will identify multiple instances in which Archegos placed orders using multiple strategies on the same day, including multiple orders with different strategies at the same time, in order to further increase the quantity purchased. Algorithms are designed to efficiently process orders pursuant to the algorithm's parameters. Each individual algorithm is designed to minimize transactions costs in the execution of an order given to that algorithm, but the algorithms are not designed to interact with each other. By using multiple algorithms at the same time, Archegos compromised the trading efficiency that could have been achieved through the use of one algorithm and caused purchases to occur at suboptimal prices.
- e. Professor Battalio will present a comparative analysis demonstrating that Archegos's active orders in the Top Archegos Securities were larger and more aggressive than active orders by other market participants. Professor Battalio will note that Archegos-linked orders came to represent a significant portion of the highest bids for the stock of its long positions than other market participants. Professor Battalio's analysis rests on a comparison between active orders reflected in the Nasdaq Order Book Data, the NYSE Daily TAQ Data, the Marketwide Trade Data, and the Archegos Order and Execution Data.
  - f. Professor Battalio will further opine that Archegos's price impact on DISCA, DISCK, IQ, and VIAC largely moved in opposition to the price impact of the trading of other

market participants—that is, Archegos-linked trading consistently reversed the demand and price signals that would otherwise have prevailed in the market absent Archegos’s orders. Professor Battalio’s opinion is based on his evaluation of price midpoint changes on Nasdaq exchanges from Archegos-linked trades versus price midpoint changes from trading of other participants.

- g. Professor Battalio will present the results of probit regression analysis evaluating market conditions prevailing at the time when Archegos increased order sizes to purchase more shares of DISCA, DISCK, IQ, and VIAC. Based on this analysis, Professor Battalio will opine that Archegos was more likely to increase order sizes when stock prices were declining, when stock prices below the previous day’s market close, shortly after market open, and shortly before market close. Professor Battalio will opine that such stock purchase decisions were consistent with a strategy to increase stock prices. Further, this analysis demonstrates that when Archegos increased order sizes, price increases often followed and that those price increases would have been observable to market participants—including Archegos itself—in market data feeds.
  - h. Professor Battalio will opine that a disproportionate amount of Archegos’s price impact in DISCA, DISCK, IQ, and VIAC results from trading undertaken at the beginning and end of the trading day. Professor Battalio will further opine that the price impact is particularly acute in the final ten minutes of the trading day. Professor Battalio will explain that this effect cannot be explained by changes in overall market volume. Professor Battalio will further explain that Archegos achieved substantial end-of-day trade volumes, in part, by increasing order sizes and limit prices near the end of the trading day.
  - i. Professor Battalio will present results of analysis demonstrating that Archegos acquired its positions in the Archegos Top Long Positions inefficiently, as measured by its implementation shortfall. Implementation shortfall refers to the deviation of execution prices from the prevailing midpoint price at the time a buy or sell order was placed.<sup>10</sup>
  - j. Professor Battalio will present results of analysis demonstrating that Archegos acquired its positions in the Archegos Top Long Positions inefficiently, as measured by realized spread. Realized spread captures the cost of trading by comparing the transaction price of a trade to the quote midpoint at a future time.<sup>11</sup>
8. Professor Battalio will opine that the prices of the Archegos Top Securities on NYSE and Nasdaq markets on multiple days between March 2020 and March 2021 and

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<sup>10</sup> See, for example, Perold, Andre F. “The implementation shortfall: Paper versus reality.” *Journal of Portfolio Management* 14, no. 3 (1988): 4.

<sup>11</sup> See, for example, Conrad, Jennifer, and Sunil Wahal. “The term structure of liquidity provision.” *Journal of Financial Economics* 136, no. 1 (2020): 239-259.

consistently between October 2020 and March 2021 resulted, in part, from Archegos's order and trading activity. Professor Battalio will further opine that, by March 23, 2021, the prevailing prices of the Archegos Top Long Positions did not reflect the ordinary operation of supply and demand but rather reflected accumulated price pressure caused by Archegos's activity. Put differently, Professor Battalio will opine that the prices of the Archegos Top Long Positions would not have reached or maintained the prices they held in March 2021 without Archegos's activity. Professor Battalio will base his opinion on the data and analyses identified above, particularly (a) Professor Battalio's micro-market price-impact studies; (b) Professor Battalio's regression analyses; (c) the price levels of the Archegos Top Securities before, during, and after Archegos amassed significant exposure to those securities and (d) comparison of the price movements of the Top Archegos Securities relative to similar companies in the same sector or the market as a whole.

**D. Approval and Signature**

I hereby approve the disclosure of my qualifications, anticipated opinions, and bases for such opinions, as set forth above.

A handwritten signature in black ink, appearing to read "Robert Battalio", is written over a light gray rectangular background.

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Professor Robert Battalio

**VITA****ROBERT H. BATTALIO**

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<b>EDUCATION:</b>	BS (Economics), Texas A&M	1988
	Ph.D. (Finance), Indiana University	1995

<b>ACADEMIC APPOINTMENTS:</b>	University of Notre Dame, January 2019 to June 2022 Department Chair
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University of Notre Dame, 2007 to present  
 Professor of Finance

University of Notre Dame, 2000 to 2007  
 Associate Professor of Finance

Georgia State University, 1999 to 2000  
 Assistant Professor of Finance

Federal Reserve Bank of Atlanta, 1999 to 2000  
 Visiting Scholar

Nasdaq Economic Research, January 1998 to December 1998  
 Visiting Academic Fellow

University of Notre Dame, 1995-1998  
 Assistant Professor of Finance

**PUBLISHED PAPERS:**

R. Battalio, 1997, "Third Market Broker-Dealers: Cost Competitors or Cream Skimmers?" *Journal of Finance* 52, 341-352.

R. Battalio, B. Hatch, and R. Jennings, 1997, "Is SOES Trading Associated with Increased Volatility?" *Journal of Financial and Quantitative Analysis* 32, 225-238.

R. Battalio, J. Greene, and R. H. Jennings, 1997, "How do Competing Specialists and Preferencing Dealers Affect Market Quality?" *Review of Financial Studies* 10, 969-93.

**PUBLISHED PAPERS (CONTINUED):**

- R. Battalio, J. Greene, and R. H. Jennings, 1998, "Order Flow, Trade Quality, and Liquidity Provision: Merrill Lynch's Decision to Cease Making Markets on the Regional Stock Exchanges." *Journal of Financial Intermediation*, 7, 338-358.
- R. Battalio, R. Jennings, and J. Selway, 2001, "The Relationship Among Market-Making Revenue, Payment for Order Flow, and Trading Costs for Market Orders," *Journal of Financial Services Research*, 19, 39-56.
- R. Battalio and C. Holden, 2001, "A Simple Model of Payment for Order Flow, Internalization, and Total Trading Cost," *Journal of Financial Markets*, 4, 33-71.
- R. Battalio, R. Jennings and J. Selway, 2001, "The Potential for Clientele Pricing when Making Markets in Financial Securities," *Journal of Financial Markets*, 4, 85-112.
- B. Hatch, R. Battalio and R. Jennings, 2001 "Post-reform Market-order Execution Quality: Multi-dimensional Comparisons Across Market Centers," *Financial Review*, 38, 123-152.
- J. Bacidore, R. Battalio and R. Jennings, 2002, "Depth Improvement and Adjusted Price Improvement on the NYSE," *Journal of Financial Markets*, 5, 169-195.
- R. Battalio, J. Greene, B. Hatch, R. Jennings, 2002, "Does the Limit Order Routing Decision Matter?," *Review of Financial Studies*, 15, 159-194.
- C. Fullenkamp, R. Tenorio, and R. H. Battalio, 2003, "Assessing Individual Risk-Attitudes Using Field Data from Lottery Games," *Review of Economics and Statistics*, 85, 218-225.
- R. Battalio, B. Hatch, R. Jennings, 2003, "All Else Equal?: A Multidimensional Analysis of Retail, Market Order Execution Quality," *Journal of Financial Markets*, 6, 143-162.
- J. Bacidore, R. Battalio and R. Jennings, 2003, "Order Submission Strategies, Liquidity Supply, and Trading in Pennies on the New York Stock Exchange," *Journal of Financial Markets*, 6, 337-362.
- R. Battalio, B. Hatch and R. Jennings, 2004, "Toward a National Market System for U.S. Exchange-Listed Equity Options," *Journal of Finance*, 59, 933-962.
- R. Battalio and R. Mendenhall, 2005, "Earnings Expectations, Investor Trade Size, and Anomalous Returns Around Earnings Announcements," *Journal of Financial Economics*, 77, 289-319.
- J. Bacidore, R. Battalio, N. Galpin, and R. Jennings, 2005, "Sources of Liquidity for NYSE-Listed Non-U.S. Stocks," *Journal of Banking and Finance* 29, 3075-3098.
- R. Battalio and P. Schultz, 2006, "Options and the Bubble," *Journal of Finance* 61, 2071-2102 (lead article).
- R. Battalio, A. Ellul, and R. Jennings, 2007, "Reputation Effects in Trading on the New York Stock Exchange," *Journal of Finance* 62, 1243-1271.



- R. Battalio, B. Hatch, and T. Loughran, 2011, "Who Benefited from the Disclosure Mandates of the 1964 Securities Acts Amendments," *Journal of Corporate Finance* 17, 1047-1063.
- R. Battalio and P. Schultz, 2011, "Regulatory Uncertainty and Market Liquidity: The 2008 Short Sale Ban's Impact on Equity Option Markets," *Journal of Finance* 66, 2013-2053.
- R. Battalio and R. Mendenhall, 2011, "Post-Earnings Announcement Drift: Timing and Liquidity Costs," *Financial Review* 46, 513-539 (Outstanding publication award).
- R. Battalio, A. Lerman, J. Livnat, and R. Mendenhall, 2012, "Who, if Anyone, Reacts to Accrual Information?," *Journal of Accounting and Economics* 53, 205-224.
- R. Battalio, A. Shkilko, and R. Van Ness, 2016, "To Pay or be Paid? The Impact of Taker Fees and Order Flow Inducements on Trading Costs in U.S. Options Markets," *Journal of Financial and Quantitative Analysis*, 51, 1637-1662.
- R. Battalio, S. Corwin, and R. Jennings, 2016, "Can Brokers Have it All? On the Relationship between Make Take Fees and Limit Order Execution Quality," *Journal of Finance* 71, 2193-2238.
- R. Battalio, S. Corwin, and R. Jennings, 2016, "Unrecognized Odd Lot Liquidity Supply: A Hidden Trading Cost for High Priced Stocks," *Journal of Trading*.
- R. Battalio, S. Figlewski, and R. Neal, 2020, "Option Investor Rationality Revisited: The Role of Exercise Boundary Violations," *Financial Analysts Journal* 76, 82-99.
- R. Battalio, T. Griffith, and R. Van Ness, 2021, "Do (Should) Brokers Route Limit Orders to Options Exchanges that Purchase Order Flow?," *Journal of Financial and Quantitative Analysis* 56, 183-211.
- R. Battalio, R. Jennings, and B. McDonald, 2021, "Deviations from Time Priority on the NYSE," *Journal of Financial Markets* 53, 1-17.
- R. Battalio, B. Hatch, and M. Saglam, "The Cost of Routing Orders to High Frequency Traders," forthcoming in *Management Science*.

#### **WORKING PAPERS:**

- R. Battalio, S. Corwin, R. Jennings, R. Zambrana, "The Role of Reputation in Financial Markets: The Impact of Broker Dark Pool Scandals on Institutional Order Routing," revise and resubmit at the *Journal of Financial Economics*.
- R. Battalio and R. Jennings, "Why do Brokers who do not Charge Payment for Order Flow Route Marketable Orders to Wholesalers?," under submission.
- R. Battalio, R. Jennings, M. Saglam, and J. Wu, "Identifying Market Maker Trades as "Retail" from TAQ: No Shortage of False Negatives and False Positives."



**WORK IN PROGRESS:**

R. Battalio, S. Corwin, R. Jennings, R. Zambrana, "Do Pension Funds & Mutual Funds use Minority and Women Brokers? Evidence from Annual Brokerage Commissions."

**PAPER PRESENTATIONS (INCLUDING THOSE BY CO-AUTHORS):**

"Third Market Broker-Dealers: Cost Competitors or Cream Skimmers - An Empirical Analysis," presented at the BI, the Securities and Exchange Commission, Indiana University, the University of Florida, Michigan State University, the Southern Big 10 Symposium, and the 1995 *Journal of Financial Intermediation's* Trading System Design Symposium.

"CBOT Membership Prices and the Value of Specialization: Theory and Evidence 1982-86.", chosen for presentation at the 1995 American Finance Association Meeting.

"How do Competing Specialists and Preferencing Dealers Affect Market Quality? An Empirical Analysis," presented at the Indiana University Symposium on the Organization of Financial Trade and Exchange Mechanism (1995), the University of Memphis Competition for Order Flow Conference, the Boston Stock Exchange, the Chicago Stock Exchange, Notre Dame University, University of Oklahoma, DePaul University, the 1996 European Finance Association Meeting, the 1997 American Finance Association Meeting, and at the 1996 Ohio State Microstructure Conference.

"Would Decimal Trading Eliminate Payment for Order Flow and Internalization?," invited for presentation at the 1997 Accounting and Finance Meetings, presented at the 1996 Ohio State Microstructure Conference, the 1997 Indiana University Market Microstructure Symposium and the 1998 Western Finance Association meetings.

"The Quality of Trade Execution on Regional Exchanges," presented at the NYSE's Conference on the Search for the Best Price and at the Chicago Stock Exchange.

"Limit Order Execution on the Philadelphia Stock Exchange," presented at the Philadelphia Stock Exchange's 1996 annual users meeting and at the University of Delaware.

"Is SOES Trading Associated with Increased Volatility?," selected for presentation at the 1997 Western Finance Association meetings and the 1997 Financial Management Association Meetings.

"Order Flow, Trade Quality, and Liquidity Provision: Merrill Lynch's Decision to Cease Making Markets on the Regional Stock Exchanges," presented at the Ohio State University, George Washington University, Georgia State University and selected for presentation at the 1997 Financial Management Association Meetings and the NBER 1997 Market Microstructure program.

"A Comparison of Equity Limit Order Execution Quality Across Trading Venues," presented at USC, Georgia State, Notre Dame, Cincinnati, the 1997 Southern Finance Association meetings, the SEC, and the 1999 American Finance Association Meetings.

**PAPER PRESENTATIONS (CONTINUED):**

“Assessing Individual Risk-Attitudes Using Field Data from Lottery Games,” presented at the 1998 Winter Meetings of the Econometric Society.

"Payment for Order Flow, Trading Costs, and Dealer Revenue for Market Orders at Knight Securities, L.P." presented at the 1999 Utah Winter Finance Meetings, the NYSE, Nasdaq Economic Research, and Georgetown University.

“Will Payment for Order Flow Survive Decimalization?,” presented at the 1999 NASD/Notre Dame market microstructure conference, the 1999 FMA meetings, and the 2000 Western Finance Association meetings.

“A Multidimensional Analysis of Retail Market Order Execution Quality,” presented at the University of Notre Dame, Georgia State University, the NASD, the Knight Trimark Group, the 1999 NYSE U.S. Equity Markets in Transition conference.

“Depth Improvement and Adjusted Price Improvement on the NYSE,” presented at the NYSE and the 2000 Western Finance Association meetings.

“Does a National Market System Exist for U.S. Exchange-Listed Equity Options?: An Analysis of Multiple Traded Equity Options,” presented at the University of Southern California, Texas A&M University, and at the 2000 Nasdaq/Notre Dame Microstructure Conference, the 2001 Western Finance Association meeting, and the 2002 American Finance Association Meetings.

“Earnings Expectations, Investor Trade Size, and Anomalous Returns Around Earnings Announcements,” presented at the 2004 American Finance Association Meetings, Indiana University, Indiana University – Purdue University Indianapolis, the University of Delaware, and the University of Notre Dame.

“Options and the Bubble,” presented at the 2005 American Finance Association Meetings, the 2005 Western Finance Association Meetings, the 2005 Morgan Stanley Equity Microstructure Conference, the University of Notre Dame, and the University of North Carolina.

“Reputation Effects in Trading on the New York Stock Exchange,” presented at the 2006 American Finance Association Meetings, the Financial Economics and Accounting Conference at the University of Southern California, Indiana University, the London School of Economics, the NYSE, the Oxford Financial Research Summer Symposium, Southern Methodist University, the University of Kansas, the University of Memphis, the University of Notre Dame, Rutgers University, and the University of Utah.

“Does the Market Value Mandated Disclosure?,” presented at the 2009 American Finance Association Meetings, the 2009 Financial Management Association Meetings, Florida State University, and the University of Notre Dame.

“Post-Earnings Announcement Drift: Timing and Liquidity Costs,” presented at the University of Utah, the University of Mississippi and the University of Notre Dame.

**PAPER PRESENTATIONS (CONTINUED):**

“Who, if Anyone, Reacts to Accrual Information?,” presented at NYU, Babson, the University of Mississippi and at Hofstra University.

"Regulatory Uncertainty and Market Liquidity: The 2008 Short Sale Ban's Impact on Equity Option Markets," presented at the at the University of Notre Dame, the University of Pittsburgh, the Ohio State University, the Federal Reserve Bank of Atlanta's conference, "Short Selling: Costs and Benefits," the 2010 Western Finance Association meetings, the 2010 FMA/UC Davis Conference on Financial Markets Research, and the 2010 RMA/UNC Academic Forum on Securities Lending.

“To Pay or be Paid? The Impact of Taker Fees and Order Flow Inducements on Trading Costs in U.S. Options Markets,” presented at De Paul University, Florida International University, the University of Miami, the University of Notre Dame, Wilfrid Laurier University, the 2012 Western Finance Association meetings, 2011 Mid-Atlantic Research Conference in Finance, and 2012 Eastern Finance Association meetings.

“Can Brokers Have it All? On the Relationship between Make Take Fees and Limit Order Execution Quality,” presented at the University of Notre Dame, Indiana University, the University of Arizona, Cornell, Vanderbilt, Direct Edge, Nasdaq, Goldman Sachs, the U.S. Securities and Exchange Commission, the 2014 Florida State University SunTrust Beach Conference, the 2014 Mid-Atlantic Research Conference in Finance, and the April 2014 NOIP Conference, and the June 17<sup>th</sup>, 2014 Senate Subcommittee on Investigation's hearings on “Conflicts of Interest, Investor Loss of Confidence, and High Speed Trading in U.S. Stock Markets.”

“Exercise Boundary Violations in American-Style Options: The Rule, not the Exception,” presented at Indiana University, IFSID 2014, the New Frontiers in Finance: Options and Volatility Conference at Vanderbilt University, European Financial Management Association 2016 meeting, China International Conference in Finance 2016, New York University, McGill University, Florida International University, and Auburn.

“Do (Should) Brokers Route Limit Orders to Options Exchanges that Purchase Order Flow?,” presented at Indiana University, the University of Notre Dame, UTEP, and the University of Memphis, the 12<sup>th</sup> annual Mid-Atlantic Research Conference in Finance at Villanova, the 2017 Washington University Theory Conference, the 2017 Northern Finance Association Annual Conference, the 2017 Financial Management Association Annual Conference, and the 3<sup>rd</sup> Annual Market Structure Conference (by the Financial Industry Regulatory Authority and Columbia University).

“The Cost of Exposing Large Institutional Orders to Electronic Liquidity Providers,” presented at the Ohio State University and University of Notre Dame, and participants at the SEC's 6<sup>th</sup> Annual Conference on Market Regulation and the 2019 WFA meetings.

“The Role of Reputation in Financial Markets: The Impact of Broker Dark Pool Scandals on Institutional Order Routing,” presented at Case Western University, the University of Notre Dame, and at the 2022 Craig Holden Memorial Conference.

**PAPER PRESENTATIONS (CONTINUED):**

“Why do Brokers who do not Charge Payment for Order Flow Route Marketable Orders to Wholesalers?,” presented at the University of Maryland and in the Microstructure Exchange online seminar series.

**OTHER INFORMATION:**

1. Former member of the NASD Economic Advisory Board (1997 – 2000).
2. Former member of the Transaction Auditing Group (TAG) Industry Advisory Board, a group consisting of 25 industry representatives whose purpose is to promote discussion on the subject of measurement of execution quality.
3. Visiting scholar at BI in Oslo, Norway during fall semester of 1997. Delivered two lectures to graduate students and one seminar to the general faculty.
4. The first visiting economist at the NASD’s department of Economic Research (January-December 1998).
5. Discussant at the 1995, 1996, and 2002 Financial Management Association Meetings, 1996, 1999, and 2003 Western Finance Meetings, and 1998, 2000, 2002 winter NBER Market Microstructure Meetings, and the RFS-IU Conference on the Causes and Consequences of Recent Financial Market Bubbles.
6. Reviewer for the 1995 Indiana University Symposium on the Organization of Financial Trade and Exchange Mechanisms, the 1996 European Finance Association Meetings, and the 1998 FMAs.
7. Occasional referee for the *Journal of Finance*, *Review of Financial Studies*, *Journal of Financial Economics*, *National Science Foundation*, *Journal of Financial Markets*, *Journal of Financial Intermediation*, *Journal of Financial and Quantitative Analysis*, *Journal of Economics and Business*, *Journal of Economics & Management Strategy*, *Financial Management*, *Organizational Science*, *Journal of Business*, *Financial Management*, *the Financial Review*, *Journal of Financial Research*, *Journal of Law and Economics*, and *Journal of Banking and Finance*, *the Journal of Futures Markets*, *the Financial Review*, *the Journal of Business Ethics*, *Management Science*, and *the Review of Asset Pricing*.
8. Member of the American Finance Association, the Society for Financial Studies, the Econometric Society, the Western Finance Association, and the Financial Management Association.

**OTHER INFORMATION (CONTINUED):**

9. Courses taught at the Undergraduate level include Introductory Financial Management, Advanced Corporate Finance, Investments, and Trading and Markets. Courses taught at the Graduate level include Investments, Trading and Markets, and the required Introductory Financial Management class in the traditional MBA program, Investments in the Executive Education program (Chicago and South Bend), and Introductory Financial Management in the Masters of Finance Program. Conducted best execution seminars for LaBranche and Susquehanna in 2002.
10. Research has been cited in the *New York Times*, the *Wall Street Journal*, the *Boston Globe*, *Inc. Magazine*, *Wall Street Letter*, *Christian Science Monitor*, *CNN fn*, *USA Today*, *Barron's*, the *Philadelphia Inquirer*, and *Securities Week*.
11. Winner of the 1999 FMA Market Microstructure best paper award.
12. Member of Vesna Straser's dissertation committee completed July 2002.
13. Winner of the 2003 BP Amaco Outstanding Teacher of the Year Award and the 2013 The Blessed Basil Anthony Moreau, C.S.C., Outstanding Undergraduate Teaching Award (both awards are chosen by seniors graduating from the Mendoza College of Business).
14. One of seven in the Mendoza College of Business to win the Kaneb Center's undergraduate teaching award in 2004.
15. Winner of a Morgan Stanley Microstructure grant in 2004 (Options and the Bubble).
16. Have consulted for the NYSE, Nasdaq, LaBranche, Fidelity, Knight/Trimark, Archipelago, NYFIX Millenium, Nasdaq, and the Susquehanna International Group. Previously served on the WhiteCap Trading board of directors.
17. Named an associate editor for the *Journal of Financial Markets* in 2006.
18. "Options and the Bubble" is one of eight finalists for the 2006 Smith Breeden Prize, awarded by the *Journal of Finance*.
19. Winner of the 2008 Arnie Ludwig Outstanding Professor Award, which is given by the students in the South Bend Executive MBA program to their favorite professor.
20. Named an associate editor of the *Financial Review* in 2010.
21. Investments track chair for the 2010 FMA Annual Meeting in New York.
22. Editor of the special issue of the *Financial Review* focusing on short selling.
23. Member of the 2011, 2012, 2013, 2014, 2015, 2016, and 2017 FIRS program committee.
24. Winner of a 2013 Q-Group award.

**OTHER INFORMATION (CONTINUED):**

25. Winner of the 2014 Blessed Basil Anthony Moreau, C.S.C. Outstanding Undergraduate Teaching Award.
26. Winner of the 2015 Department of Finance James Dincolo Teaching Award.
27. Testified before the U.S. Senate Subcommittee on Investigations of the Committee on Homeland Security and Government Affairs on July 17, 2014 regarding conflicts of interest in the U.S. equity markets.
28. Testified before the U.S. Securities and Exchange's Equity Market Structure Advisory Committee regarding make take fees and conflicts of interest in U.S. equity markets in October 2015.
29. Winner of the 2016 and the 2020 MSF Outstanding Professor Award.
30. Member of the Nasdaq Quality of Markets Committee.
30. Winner of the 2017 Rev. Edmund P. Joyce, C.S.C. Award for Excellence in Undergraduate Teaching.
31. Member of the 2017, 2018, 2019, 2020, 2021, and 2022 Western Finance Association program committee.
32. Member of Nasdaq's Quality of Markets Committee (2016 to present).
33. Served as the expert witness for the plaintiffs in Strougo v. Barclays. Case was settled for \$27 million.
34. Panelist on SIFMA's Equity Market Structure Roundtable in September 2022.
35. Discussant at the 2022 NBER Fall Behavioral Finance Conference and at the 2022 Texas Finance Festival.
36. Expert witness in Securities and Exchange Commission v. Suyun Gu, et al.

## APPENDIX B

### Published Papers and Books

Bacidore, Jeff. *Algorithmic Trading, A Practitioner's Guide*. Algorithmic Trading. TBG Press, 2020.

Battalio, Robert H., Robert H. Jennings, Mehmet Saglam, and Jun Wu. "Identifying Market Maker Trades as 'Retail' from TAQ: No Shortage of False Negatives and False Positives." *Available at SSRN* 4579159 (2023).

Battalio, Robert, Brian Hatch, and Mehmet Sağlam. "The cost of exposing large institutional orders to electronic liquidity providers." *Management Science* (2023).

Beason, Tyler, and Sunil Wahal. "The anatomy of trading algorithms." *Available at SSRN* 3497001 (2020).

Bertsimas, Dimitris, and Andrew W. Lo. "Optimal control of execution costs." *Journal of financial markets* 1, no. 1 (1998): 1-50.

Chakravarty, Sugato. "Stealth-trading: Which traders' trades move stock prices?." *Journal of Financial Economics* 61, no. 2 (2001): 289-307.

Conrad, Jennifer, and Sunil Wahal. "The term structure of liquidity provision." *Journal of Financial Economics* 136, no. 1 (2020): 239-259.

Frazzini, Andrea, Ronen Israel, and Tobias J. Moskowitz. "Trading costs." *Available at SSRN* 3229719 (2018).

Griffin, John M., Jeffrey H. Harris, and Selim Topaloglu. "The dynamics of institutional and individual trading." *The Journal of Finance* 58, no. 6 (2003): 2285-2320.

Harris, Larry. *Trading and exchanges: Market microstructure for practitioners*. OUP USA, 2003.

Lynch, Anthony W., and Richard R. Mendenhall. "New evidence on stock price effects associated with changes in the S&P 500 index." *The Journal of Business* 70, no. 3 (1997): 351-383.

Perold, Andre F. "The implementation shortfall: Paper versus reality." *Journal of Portfolio Management* 14, no. 3 (1988): 4.

### Additional Data Sources

#### *Algorithmic Execution Guides*

SDNY\_P001\_0000584711

SDNY\_P001\_0000359924

SDNY\_P001\_0000096920

SDNY\_P001\_0002868914

SDNY\_P001\_0004572847

***Archegos Order and Execution Records***

SDNY\_P002\_0000023044

SDNY\_P002\_0000023045

SDNY\_P001\_0006396405

SDNY\_P001\_0006396410

SDNY\_P003\_0000000507

SDNY\_P002\_0000065205

SDNY\_P001\_0006143531- SDNY\_P001\_0006242580

SDNY\_P001\_0000094501- SDNY\_P001\_0000094548

***Archegos Trading IB Records***

SDNY\_SWR\_0000255918 - SDNY\_SWR\_0000316566

***Marketwide Trade Data***

SDNY\_P016\_0000010801 - SDNY\_P016\_0000010802

***Nasdaq Order Book Data***

SDNY\_001\_00000623

***NYSE Integrated Feed***

The Government will facilitate your access to this data through the NYSE.

***NYSE Daily TAQ Data***

SDNY\_P016\_0000000001